

HABITAT USE OF TWO SONGBIRD SPECIES IN PINE-HARDWOOD FORESTS TREATED WITH PRESCRIBED BURNING AND THINNING: FIRST YEAR RESULTS

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Abstract—We evaluated habitat use and home range size of hooded warblers (*Wilsonia citrina*) and worm-eating warblers (*Helminthos vermivorus*) in six treated mixed oak-pine stands on the Bankhead National Forest in north-central AL. Study design is a randomized complete block with a factorial arrangement of three thinning levels (no thin, 11 m²/ha residual basal area, and 17 m²/ha residual basal area) and two burn treatments (burn and no burn). Data used in this analysis included those collected from the first of three replications during the first post-treatment year, between May and July 2006. Habitat use and territory size were quantified via territory mapping based on radio telemetry and burst sampling methods. Habitat variables collected within and outside territories were used to determine habitat preferences. Our results suggest that birds on the treatment plots relied on areas left untreated in the stand or uncut areas adjacent to cut stands. Home ranges of both species were relatively large. Habitat within home range had a greater slope, canopy cover, number of trees, basal area, and tree species richness than unused areas.

INTRODUCTION

Many migratory bird species have experienced population declines in past decades, primarily due to loss of suitable habitat from anthropogenic disturbances (Askins and others 1990, Robbins and others 1989). One of the factors contributing to habitat loss for many bird species in the United States is forest management practices that prevent natural disturbance (i.e., fire suppression, pine plantations) (Rappole and McDonald 1994), leading to the breakdown of ecological processes and “unhealthy” forest ecosystems.

To restore forest ecosystem health, canopy reduction and prescribed burning have been used to simulate natural disturbance. Early research shows that such disturbances can affect resource abundance and availability on which birds rely (Wiens 1989). Disturbance can trigger changes in habitat, food and nest-site availability, predation, and nest-parasitism (Wiens 1989). Such alterations can affect the likelihood of breeding success.

Territory size varies depending on habitat quality, with poor quality habitat resulting in the need for a larger territory (Mazarolle and Hobson 2004). During the breeding season, the purpose of defending a territory is to ensure sufficient resources to raise offspring (Wilson 1979). Territory size is a function of expected prey abundance which birds base on structural habitat cues (Smith and Shugart 1987). There appears to be a habitat quality gradient defined by relationships between habitat structure and prey abundance which influence variation in territory size (Smith and Shugart 1987).

Because birds rely on available resources in their territory, different silvicultural treatments may result in birds having differing territory sizes to adequately access resources and successfully fledge young. Research has focused on the effect of fragmentation on territory size and resource abundance (Mazarolle and Hobson 2004, Norris and others

2000, Roberts and Norment 1999), but few experimental studies have been implemented to determine the effect of silvicultural treatments on avian ecology.

In this study, we evaluated the effect of forest disturbances, specifically thinning and prescribed burning, on the avian community. We examined disturbance effects on avian home range size and one of the mechanisms (habitat structure and composition) responsible for changes in avian population demographics. The objectives of this study are to (1) determine home range and core area size of two songbird species in areas treated by thinning and burning, (2) determine the extent to which songbirds are using treated areas, and (3) compare differences in habitat within and outside of songbird home ranges. Results presented here are based on data collected during the first post-treatment year (2006).

METHODS

Study Sites

This study took place in the northern third of the William B. Bankhead National Forest (BNF) located in Lawrence and Winston counties, northwestern AL. Much of this area has been infested by the southern pine beetle (*Dendroctonus frontalis*). Therefore, to restore forest health, BNF has initiated a Forest Health and Restoration Project (Gaines and Creed 2003), which provided the experimental framework for this project. Eighteen study plots were located on upland sites composed of 20 to 35 year old loblolly pine (*Pinus taeda*). Average plot size was 9 ha and plots had similar location, age, and stand density.

Experimental Design

Research followed a randomized complete block design. Forest manipulations consisted of two factors, thinning (no thin, 11 m²/ha residual basal area, and 17 m²/ha residual basal area) and burning (no burn and burn). Each of these were replicated three times and blocked by year. The results

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in this paper are from the first block of treatments (six study plots). Treatments were completed between August 2005 and February 2006. During thinning, hardwoods were preferentially retained. All thinning was completed before fire prescriptions. Prescribed burning was performed in the dormant season (January to March) with low-burning surface fires.

Target Species

The hooded warbler (*Wilsonia citrina*) and the worm-eating warbler (*Helmitheros vermivorus*) were chosen as target species because of their pretreatment abundance and their life history traits. Both are insectivorous forest-interior species that inhabit mixed hardwood forests (Evans Ogden and Stutchbury 1994, Hanners and Patton 1998). Hooded warblers prefer small openings and a shrub understory for nesting (Evans Ogden and Stutchbury 1994), whereas worm-eating warblers prefer areas with high canopy cover and patches of shrub cover and nest on the ground, usually on slopes (Hanners and Patton 1998).

Home Range Estimation

Males of each target species were captured using song playback to attract them into mistnets. Each captured bird was banded with a US Fish and Wildlife Service numbered aluminum band and plastic color bands to aid in individual identification. A radio transmitter (Model BD-2, 0.065 g [4-5 percent of body mass], Holohil Systems, Ltd.) was also attached to the back of the bird using a figure-8 harness (Rappole and Tipton 1991) made of cotton thread and secured with super glue. All birds were released immediately after processing and tracked after 48 hours to allow them to adjust to the leg bands and radio transmitter.

Birds were tracked using burst sampling (Barg and others 2005). Bird locations were recorded at 60 second intervals for a total of 30 points per session. If the bird was lost during the session, recording temporarily stopped until the bird could be relocated; each session lasted between 30 and 80 minutes. Each bird was tracked every three to four days, and we performed as many sessions as possible before the transmitter battery died. Each location was recorded using a handheld global positioning system (eTrex Vista, Garmin Ltd.) and downloaded into ArcGIS v. 9.1 (ESRI) for analysis.

Habitat Analysis

Six habitat plots were established for each bird after the breeding season – three inside the home range and three

outside the home range but within the treated area. Habitat features were measured after the breeding season (July) using concentric circular plots with a method modified from James and Shugart (1970). We recorded species and size class of all trees greater than 7.62 cm diameter at breast height (d.b.h.) and basal area within a 11.3-m radius (0.04 ha); the number of woody and herbaceous stems within a 5-m radius; and the percent ground cover within a 1-m radius. Percent canopy cover, vertical cover, and litter depth were recorded in cardinal directions 5 m from the plot center. Aspect and percent slope was recoded at each plot center.

Statistical Analysis

A t-test was used to determine differences between habitat within and outside of home ranges after calculating averages for each bird based on three plots. Statistical tests were carried out at the 0.05 significance level using SPSS v.10.0. Home range and core areas were delineated with the Home Range Tools extension for ArcGIS v. 9.1 (Rogers and others 2005). Home ranges were estimated using adaptive kernel density estimators with a smoothing parameter selected through least squares cross validation (Seaman and Powell 1996). The resulting home range kernel was divided into probability contours in increments of 10 percent, and the center 10 percent was considered as the core area.

RESULTS

Captures

Twenty-three birds were caught and banded (13 worm-eating warblers and 10 hooded warblers). Fifteen of these birds were consistently seen on the plots throughout the season, two birds disappeared mid-season, and eight birds were never seen again after banding. Of the 15 'regulars', we tracked six birds (two worm-eating warblers and four hooded warblers). We attached radio transmitters to all but one of these birds. The majority of the tracked birds were located in the thinned plots (table 1). An average of 184 points per bird was collected.

Home Range and Habitat Use

Average home range size was 14.58 ha (range: 0.50 to 31.01 ha) for hooded warblers and 20.45 ha (range: 20.14 to 20.75 ha) for worm-eating warblers. The average core area was 0.38 ha for hooded warblers and 0.64 ha for worm-eating warblers. Average home range located within the treated area was 45.2 percent (range: 26.2 to 71.5 percent) for hooded warblers and 40.2 percent (range: 30.33 to 50.1 percent) for

Table 1—Distribution of target species across treatment plots

Treatment	Caught/Banded (‘Regulars’)	Tracked
Control	4 (3 WEWA ^a , 1 HOWA ^b)	0
Thin	9 (4 WEWA ^a , 5 HOWA ^b)	5 (1 WEWA ^a , 4 HOWA ^b)
Burn	0	0
Thin and Burn	2 (1 WEWA ^a , 1 HOWA ^b)	1 (WEWA ^a)

^a Worm-eating warbler (*Helmitheros vermivorus*)

^b Hooded warbler (*Wilsonia citrina*)

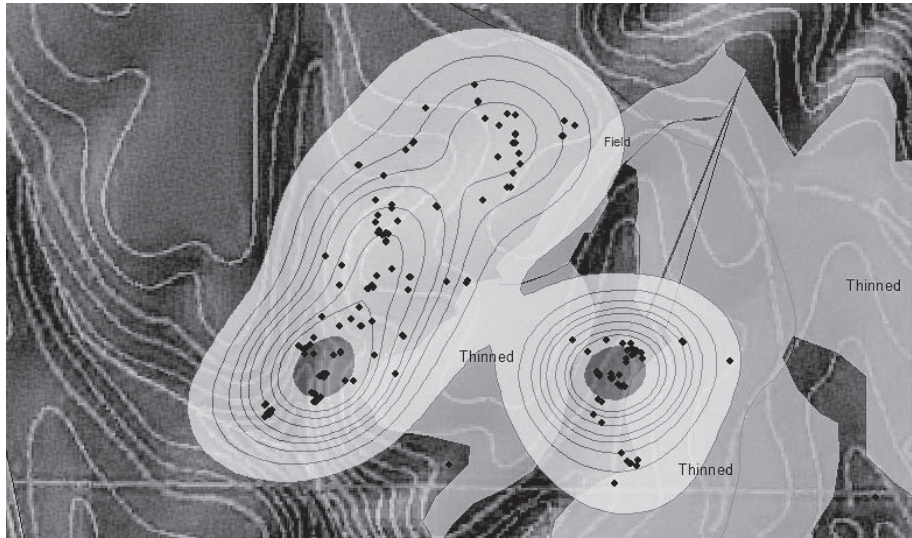


Figure 1—Map of a hooded warbler home range, Bankhead National Forest, May – June 2006. Light grey indicates the bird's home range (center darker area is the core area) and dark grey indicates the thinned area, the remaining area was not treated. Closed circles are locations of individual bird observations.

worm-eating warblers (fig. 1). Habitat within home range was higher in slope, canopy cover, the number of trees, basal area, and tree species richness than unused areas (table 2).

DISCUSSION

Wilson (1979) defines home range as the total area which an animal inhabits. For songbirds, it often is larger than the bird's territory and encompasses the total area the bird travels. The entire home range is not necessarily defended as the territory is; however, the defended territory is included within the boundaries of the home range. The core area is the area of heaviest regular use within the home range, and it may be parallel to the defended territory. For songbirds, the territory is the easiest area to measure because the individual defends this area by singing; therefore, it can be determined by identifying the locations where the bird sings. The home range proves harder to identify because the bird does not always "advertise" his location by singing. Radio telemetry makes it possible to locate the birds in all parts of its home range, even when not singing.

Previously reported territory size ranges from 0.50 ha to 6.54 ha for hooded warblers (Evans Ogden and Stutchbury 1994, Norris and others 2000) and is approximately 1.72 ha for worm-eating warblers (Hanners and Patton 1998). There no information is available regarding home range size for either species. The home range sizes found in this study (15 ha for hooded warbler and 20 ha for worm-eating warbler) were relatively large. This could indicate the habitat quality of our study site was low. A larger area is needed to accommodate the bird's needs at poorer sites. It is evident in the distribution maps that the birds probably used the thinned areas as a way to access non-thinned areas that were separated by thinned areas. For some individuals, there were no observation points collected within the thinned areas; however the home range often extended across the thinned plot where the bird moved to access untreated areas (fig. 1).

Birds are choosing habitat that has more trees, greater canopy closure, and higher tree variety than habitat available in thinned areas. This could be because more vegetation provides them with more cover and nest sites. The habitat

Table 2—Significant habitat variables within (used) and outside (available) of bird home ranges

Habitat Variable	Used	Available	p-value
Slope	22.24 %	8.53%	0.0001
Canopy cover	80.82 %	65.18%	0.0003
Number of trees ^a	24.67	14.8	0.0022
Tree species richness	6.93	4.97	0.0053
Basal area	70.25 ft ² per ac	54.7 ft ² per ac	0.05

^a Number of trees in 0.01 acre circular plot.

the birds are choosing most likely has greater food resources than the thinned areas. Increased vegetation is positively correlated with food availability (Marshall and Cooper 2004, White 1984) and many arthropods are positively associated with interior forest, away from edges (Kilgo 2005). Little information is available on the specific habitat requirements of either species, but both species inhabit the forest interior and are not as productive in fragmented forests as in contiguous forests (Gale and others 1997, Kilgo 2005, Norris and others 2000).

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